Geosyntec consultants

Memorandum

Date:	26 August 2013
To:	**Jill McKenzie**, **Dave Barskey**, **Gloria Depaolis**, NJDEP
Copies to:	**Dawn Horst**, Ingersoll Rand, **Stan Schrek**, Van Cleef Engineering Associates, LLC
From:	**Mike Lambert**, P.G., **Scott Drew**, L.S.R.P., Geosyntec Consultants
Subject:	Former Ingersoll Rand Facility, Phillipsburg, NJ – Lot 4.01 Monitoring Well Installation

On behalf of Ingersoll Rand, Geosyntec is notifying the department of the plan to install a groundwater monitoring well within Lot 4.01 of the former Ingersoll Rand (IR) facility in Phillipsburg, NJ. The installation will be conducted during the second half of September, 2013. The purpose of this monitoring well is to evaluate groundwater for the presence of volatile organic compounds (VOCs) hydraulically downgradient of a soil VOC "hotspot" identified in the north central portion of Lot 4.01. Several VOCs have been identified in soils that exceed the NJDEP default Impact to Groundwater Soil Screening Level, including chlorinated VOCs.

The proposed monitoring well will be installed near the southwestern boundary of Lot 4.01, as shown on the attached Figure 1. The location and depth of the monitoring well was selected based on the following technical considerations:

- Groundwater elevation contours from recent groundwater sampling events including April 2012, October 2012 and April 2013. The contours generally indicate that groundwater flows in the south-southwest direction nearly parallel to bedrock strike.

- Bedrock strike orientation is approximately N27°E with a dip of 45° to the southwest. Previous groundwater investigation activities have identified a horizontal anisotropy oriented parallel to bedrock strike, with a significant reduction in hydraulic connection in the dip direction. Evidence for this was observed in a 2005 groundwater pumping test conducted at MW-6. A strong hydraulic connection was identified 400 feet along strike (in the downgradient direction) in MW-35, with lesser connections along dip. This information corroborates the idea that the predominant groundwater flow direction is parallel to bedrock strike.

- Borehole packer testing was conducted in several proximal monitoring wells, most notably MW-35 which is located approximately 20 feet northwest of the soil hotspot. At that location, the August 2005 packer testing results indicates the packed intervals less than 123 feet in depth contained higher VOC concentrations than the borehole packed interval of 124 – 143 ft. depth (ENSR, 2006, Groundwater Annual Monitoring Report). Specifically, total VOC

concentrations detected in the 93 to 123 ft., 110 to 123 ft. and 124 to 143 ft. intervals during the August 2005 packer testing were 93.8 µg/L, 87.3 µg/L and 61.5 µg/L, respectively. This suggests that vertical VOC migration is limited.

As shown on Figure 1 the proposed monitoring well location is approximately 200 feet south-southwest and directly down-strike of the VOC soil hotspot. Based on the information provided above and the groundwater CSM it is expected that the highest concentrations of VOCs would be present down-strike of the hotspot. The target drilling depth of the proposed monitoring well is 170 below ground surface. While it is anticipated that the highest groundwater VOC concentrations will be encountered at shallow depths (based on the MW-35 results), characterization will be conducted to 170 feet to understand the borehole flow regime and vertical distribution of VOCs in the bedrock fractures.

The installation approach for the proposed monitoring well includes the following sequence of activities:

1. Advance a 12" temporary steel casing to the top of competent bedrock (anticipated to be approximately 60 feet below ground surface [bgs]) and an $11^{5}/_{8}$" borehole to a depth of 10 feet below the top of competent bedrock using a dual air rotary drill method.

2. Install 8" steel casing to a depth of 10 feet below top of competent bedrock and seal annular space in the borehole with grout as part of a double-cased monitoring well construction.

3. Advance a 6" borehole to a depth of 5 feet below the water table (anticipated to be 95 feet bgs) using a conventional air rotary drill method.

4. If the borehole remains open, continue advancement of the 6" borehole to a depth of 170 feet bgs (total depth). If borehole collapse occurs, re-engage the dual rotary drill method to advance a cased borehole.

Proposed sequence of activities if borehole remains open:

5. Perform geophysical logging on the borehole that remains competent/open during advancement to identify and characterize the fracture zones. The geophysical logging will include caliper, single point resistance, 16-64 normal resistivity, spontaneous potential, natural gamma and fluid resistivity/temperature logs. Vertical flow conditions in the borehole will be evaluated by a heat pulse flowmeter test and an acoustic televiewer will be utilized to image the fracture aperture and orientation.

6. Complete packer testing on selected fracture intervals to isolate water bearing zones for hydraulic and water quality information. During packer testing, water levels will be monitored

in existing proximal monitoring wells MW-35 and MW-50 to evaluate a potential hydraulic connection. Purge and sample groundwater from each isolated water bearing zone using a volumetric purging method (3-5 volumes) and collect groundwater samples with a Teflon bailer for analysis of VOCs by Method 8260B.

Proposed sequence of activities if borehole does not remain open:

5. Engage the dual rotary drill method to advance 6" temporary steel casing to a depth of 100 feet bgs. Purge and sample groundwater from the cased borehole using a volumetric purging method (3-5 volumes) and collect a groundwater sample with a Teflon bailer for analysis of VOCs by Method 8260B.

6. Advance the temporary steel casing at 20 ft. depth intervals using the dual rotary drill method/equipment, and collect a groundwater sample at each 20 foot interval using a volumetric purge method.

Proposed sequence of activities following drilling and sampling:

7. Based on the analytical results of the borehole groundwater sampling and nearby monitoring well construction, construct the new monitoring well in accordance with the Technical Requirements for Site Remediation (N.J.A.C. 7:26E) and the Well Construction requirements (N.J.A.C. 7:9D). The monitoring well will be completed with a protective steel stick-up riser and cover.

8. Develop the monitoring well by use of a surge block and over-pumping method. During development water quality parameters will be monitored for stabilization.

9. Allow the new monitoring well to stabilize for at least two weeks after well development and prior to initial groundwater sampling. The initial groundwater sampling of the completed well will coincide with the October 2013 sampling event.

10. Survey the monitoring well for vertical and horizontal control.

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MW51A	
CVOC:	ND
Perf. Casing (ft bgs):	115-135
Perf. Casing (ft msl):	232-212
GWE (ft msl):	256.35

MW33A	
CVOC:	7.54
Open Hole (ft bgs):	49.5-125
Open Hole (ft msl):	301-226
GWE (ft msl):	255.30

MW02A	
CVOC:	0.99
Open Hole (ft bgs):	60-125
Open Hole (ft msl):	294-229
GWE (ft msl):	266.22

MW06	
CVOC:	3.94
Screen (ft bgs):	167-192
Screen (ft msl):	183-158
GWE (ft msl):	250.70

MW03	
CVOC:	0.92
Open Hole (ft bgs):	25-110
Open Hole (ft msl):	315-230
GWE (ft msl):	277.71

MW34	
CVOC:	5.62
Open Hole (ft bgs):	75.5-130
Open Hole (ft msl):	275-221
GWE (ft msl):	252.33

MW57	
CVOC:	3.42
Screen (ft bgs):	85-95
Screen (ft msl):	250-240
GWE (ft msl):	252.01

MW50	
CVOC:	0.82
Open Hole (ft bgs):	58-155
Open Hole (ft msl):	288-191
GWE (ft msl):	251.89

MW58S	
CVOC:	ND
Screen (ft bgs):	60-90
Screen (ft msl):	269-239
GWE (ft msl):	250.86

MW58D	
CVOC:	1.59
Screen (ft bgs):	101-106
Screen (ft msl):	228-223
GWE (ft msl):	250.88

MW35	
CVOC:	155.41
Open Hole (ft bgs):	49.5-145
Open Hole (ft msl):	300-205
GWE (ft msl):	250.85

MW39	
CVOC:	ND
Open Hole (ft bgs):	24.5-150
Open Hole (ft msl):	316-191
GWE (ft msl):	260.42

MW36	
CVOC:	ND
Open Hole (ft bgs):	24.5-150
Open Hole (ft msl):	308-183
GWE (ft msl):	227.87

Walnut St
Thomas St
Chestnut Aly
Webster Aly
Peach Aly
James St
Wilbur Ave
Pursel St
Griffith Aly
Mill St
Allen Aly
Columbus Ave
Stewart Aly
Culkin St
Green St
Congress St
Hillside Rd
Gate St
Farm

Allentown Dolomite

Beekmantown Group Lower Part

274
270
266
262
258
254
250
246
242
238
234
230

Inferred BR Strike

Proposed Monitoring Well

254
258

N

Legend

- Proposed Monitoring Well Location
- Monitoring Well Locations
- VOC Delineation Area
- Groundwater Elevation Contour (April 2013)
- Warren County Bedrock Geology - Contact
- Surface Water Features and Drainages
- Fenceline
- Former Ingersoll Rand Property Boundary
- Buildings
- Lot4.01

The CVOC concentrations (µg/L) reported include the total concentrations of 1,1,1-Trichloroethane,1,1-Dichloroethane, 1,1-Dichloroethene, cis-1,2-Dichloroethene, Tetrachloroethene and Trichloroethene in April 2013. The CVOCs included in these total concentration values are the chlorinated ethane and chlorinated ethene compounds detected in April 2013.

250 125 0 250 Feet

Proposed Monitoring Well Location
Lot 4.01

Former Ingersoll Rand Facility,
Phillipsburg, NJ

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Princeton, NJ | 19-Aug-2013

Figure 1

Path: P:\GIS\GISProjects\JR0024 - IR Phillipsburg\Projects\Lot4.01 ProposedMW.mxd